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19 May 95

MEMORANDUM FOR AGMC/EM
ATTN: Mr. Rob Large
813 Irving-Wick Dr. W
Newark AFB, OH 43057-0018

FROM: HQ AFCEE/ERT
8001 Arnold Drive
Brooks AFB, TX 78235-5357

SUBJECT: Completion of One-Year Bioventing Test, Newark AFB Site N1 (Facility 27), Site N2 (Facility 89), and Site N3 (Facility 14)

The Air Force Center for Environmental Excellence (AFCEE) one-year bioventing test and evaluation projects at Newark AFB have been completed. A site map (Figure 1) and two tables (Table 1 and Table 2) are attached for two of the three sites listed above. Figure 1 provides general site information; Table 1 provides a summary of initial, interim, and final respiration and degradation rates measured at various monitoring points at each site; and Table 2 provides a summary of initial and final soil and soil gas analytical results for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX) at each site. Neither an air permeability test nor an insitu respiration test was conducted at Site N3. Originally, these tests were to be conducted at a later date if funding was available. However, the site has been declared clean by the state of Ohio and no further work is planned for this site. Therefore, only initial site activities and soil sampling were performed.

Based on the results from your sites and numerous other sites throughout the Air Force, bioventing is cost-effectively remediating fuel contamination in a reasonable time frame. We recommend that other sites at your facility be evaluated for possible use of this technology. The sites should be evaluated using the criteria in the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, May 1992, including Addendum One, February 1994. These are found in the "Tool Box" recently sent to your base.

The objective of the sampling and evaluation effort was not to collect enough samples for a statistical evaluation, but rather to demonstrate the feasibility of using bioventing to reduce TRPH and BTEX concentrations in fuel-contaminated soil and soil gas. The results of soil and soil gas sample analyses and respiration testing were used to evaluate the performance of this technology for each site.

Soil gas samples are similar to composite soil samples in that they are collected over a larger vertical interval than a discrete sample collected at a specific depth. Thus,

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they provide an indication of changes in soil gas profiles and volatile contaminant concentrations (see Addendum One to the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing-Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential, February 1994). Soil samples, on the other hand, are discrete point samples subject to large variabilities over small distances and/or soil types. Because of the wide variations inherent in the soil sample collection and analysis process, the analytical results from soil samples alone should not be viewed as conclusive indicators of bioventing progress or evidence of the success or failure of this technology. For this reason, in situ respiration tests and associated soil gas sampling and analysis are considered better indicators of hydrocarbon remediation than limited soil sampling.

The following paragraphs provide site specific information on the analytical results from samples collected at the bioventing sites at Newark AFB.

Site N3 - Facility 14

An air permeability test and an in situ respiration test were not conducted at this test site. No additional data have been provided.

Site N1 - Facility 27

Degradation rates at the two locations for which data were available showed a significant decrease between the initial and one-year sampling events, indicating a decrease in the amounts of fuel available for degradation. Data for two of the locations for the final rate calculations were not available (Table 1).

Comparison of the initial and final soil gas analytical results indicated a decrease in TPH concentrations at location MPA-6.5 (Table 2). Benzene concentrations at the monitoring point decreased, while toluene, ethylbenzene and xylenes concentrations slightly increased at this location. Although the other initial and final soil gas samples were collected from different locations, the general trend supports a decrease in both TPH and BTEX concentrations. These measurements indicate that fuel biodegradation progressed at a significant rate during the first year. The initial TPH concentrations in the soil samples at both sampled locations were below the state of Ohio action level of 105 ppm for TPH in soils. The TPH concentration in the one-year sample collected at location MPA-8.0 increased from the initial concentration of 36 ppm to 170 ppm. Variations in the one-year soil samples' TPH values may be explained by the variations naturally introduced by soil sampling techniques. Initial BTEX concentrations were non-detect for both samples; however, low concentrations (i.e., parts per billion) for benzene, toluene, and xylenes were detected with the one-year follow-up sampling. Again, these slight increases can be explained by the variations caused by soil sampling techniques.

Site N2 - Facility 89

Degradation rates at the four locations for which multiple sets of data were available showed a significant decrease between the initial and final sampling events, indicating a decrease in the amount of hydrocarbons available for degradation (Table 1). The degradation rate at one location (MPA-2.0) between the six-month and one-year monitoring periods showed an uncharacteristic, but substantial, increase.

TPH concentrations in soil gas at locations MPC-6.5 and MPC-9.0 increased slightly between the initial and final sampling events (Table 2). Benzene, toluene, and ethylbenzene concentrations decreased to non-detect at both sampling locations. Xylene concentrations decreased to 0.004 ppm at location MPC-6.5 and to non-detect at location MPC-9.0. The initial TPH concentrations in the soil samples were non-detect at two of the three locations sampled. The TPH in the soil decreased from 31 mg/kg to 12 mg/kg at the vent well. This concentration is well below the state of Ohio action level of 105 mg/kg for TPH in soils. BTEX concentrations in the soils were very low during the entire bioventing study, making it difficult to perform a meaningful comparison of the initial and final results. Benzene and ethlybenzene were non-detect throughout the study, but toluene and xylene showed detectable concentrations during the one-year follow-up sampling.

Based on the positive results of this evaluation, AFCEE recommends that the bioventing pilot system at each site continue to operate. However, due to the low TPH and BTEX concentrations in the one-year soil samples, it is recommended that the risk assessments for these sites be evaluated and the potential for conducting closure sampling be considered. Continued monitoring and/or closure sampling for any of these sites can be contracted through AFCEE. Please contact Lt. MaryAnn Jenner, AFCEE/ERT, DSN 240-4364, COM 210-536-4364, to discuss technical and contractual options for these sites.

Data from your base and many others indicate that BTEX compounds are preferentially biodegraded over TRPH. Since BTEX compounds represent the most toxic and mobile fuel constituents, a BTEX standard is a risk-based standard. We strongly encourage its use over an arbitrary TPH standard. Within the AFCEE Risk-based Petroleum Hydrocarbon "Tool Box," the report "Using Risk-based Standards Will Shorten Cleanup Time at Petroleum-Contaminated Sites" summarizes the BTEX/TPH issue and will assist you in negotiating for a BTEX cleanup standard.

In general, quantitative destruction of BTEX can be accomplished through bioventing. The time frame for this destruction to occur is based on a variety of factors, such as initial contaminant concentrations, site lithology, and depth to groundwater. Soil gas surveys and respiration tests can be used as BTEX destruction indicators. If a non-risk-based/TRPH cleanup is chosen, the pilot and full-scale systems should be operated until respiration rates approach background rates. We recommend that confirmatory soil sampling be conducted four to six months after background respiration rates are approached.

Due to the streamlined nature of this evaluation project, the interim results report and this letter will be the only project documentation provided to the base. The interim results report contains site diagrams and analytical results from initial soil and soil gas samples. Attachments to this letter provide the analytical results for the final soil and soil gas samples, and this letter provides a summary of the collected data and recommendations for follow-on activities. AFCEE is no longer responsible for the operation, maintenance, or monitoring of the bioventing sites. We have initiated a contract to extend monitoring at some sites beyond the initial one-year test. Monitoring will include soil gas and respiration tests to document hydrocarbon degradation, but also may include the collection of sufficient final soil samples to statistically demonstrate site cleanup. If you are interested, please call us.

The blowers and accessories are now base property and should continue to be used on this or other bioventing sites. Although the current equipment is explosion-proof, under no circumstances should it be used for soil vapor extraction unless appropriate explosion-proof wiring is provided. If the base does not want to keep the blowers or if you have further questions, please contact us.

On behalf of the AFCEE/ERT staff, I would like to thank you for your support of these bioventing test and evaluation projects. The information gained from each site will be invaluable in evaluating this technology and will promote its successful application on other Department of Defense (DOD), government, and private sites. I have attached a customer satisfaction survey. Please take a few minutes to fill it out and tell us how we did. We look forward to hearing from you.

ROSS N. MILLER, Lt Col, USAF, BSC
Chief, Technology Transfer Division

Attachments:
1. Figure 1(2 each)Site
2. Table 1(2 each)Respiration and Degradation Rate Tables
3. Table 2(2 each)Initial and One-Year Soil and Soil Gas Analytical Results Tables
4. Survey

cc: AFCEE/ERB (Mr. Fred Waterman)
AL/EQW (Ms. Cathy Vogel)
AFBCA/EV
Battelle (Mr. Rob Hinchee)

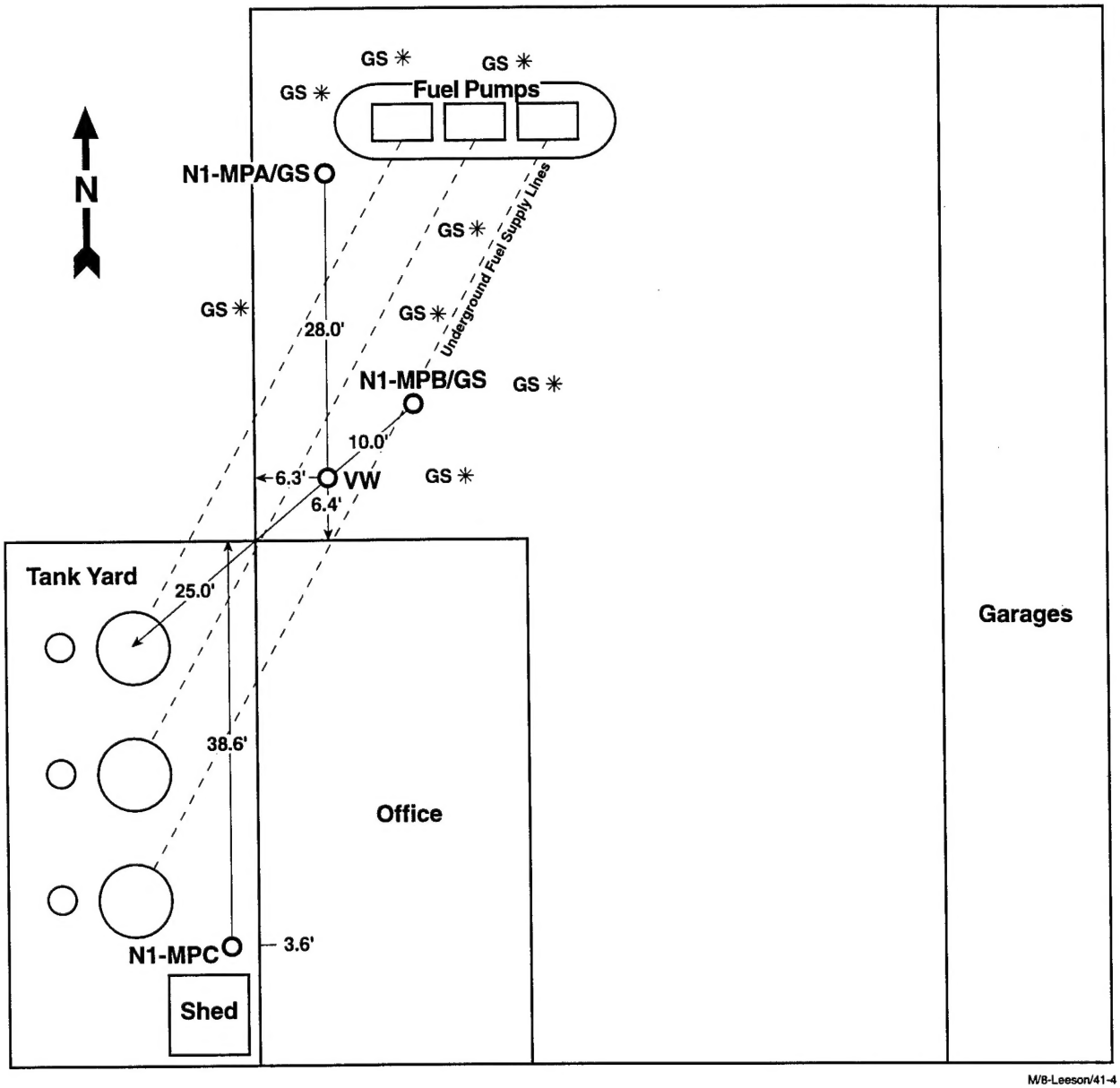

Figure 1. Schematic Diagram of Facility 27, Newark AFB, OH, Showing Locations of the Vent Well, Monitoring Points, and Soil Gas Survey Points

Table 1. Respiration and Degradation Rates at Facility 27, Newark AFB, OH

Location	Initial: August 12, 1992			6-Month[1]: April 5, 1993			1-Year: November 8, 1993		
	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)
MPA-6.5	9.4	2,700	18.9						
MPA-9.0	2.6	760	20.0				0.71	210	
MPB-6.5	6.5	1,900					0[2]	0[2]	
MPB-9.0	6.2	1,800							

1 Site not oxygenated. No in situ respiration test conducted.
2 No respiration observed at this monitroing point.

Table 2, Initial and 1-Year Soil and Soil Gas Analytical Results at Facility 27, Newark AFB, OH

Analyte (units)	Sample Location					
Soil Gas Hydrocarbons	MPA-6.5		MPC-8.0	VW	MPA-4.0	MPB-8.0
	Initial August 10, 1992	1-Year December 14, 1993	Initial August 10, 1992	Initial August 10, 1992	1-Year December 14, 1993	1-Year December 14, 1993
TPH (ppm)	2,200	9.0	130	80	7.0	15
Benzene (ppm)	0.046	0.0070	0.0050	ND	ND	ND
Toluene (ppm)	0.0080	0.015	0.0060	0.056	ND	ND
Ethylbenzene (ppm)	ND	0.0040	ND	0.026	ND	ND
Xylenes (ppm)	0.0030	0.20	ND	0.31	0.018	ND
Soil Hydrocarbons	MPA-8.0		MPA-4.0			
	Initial July 30, 1992	1-Year November 11, 1993	Initial July 30, 1992	1-Year November 11, 1993		
TPH (mg/kg)	36	170	49	14		
Benzene (mg/kg)	ND	ND	ND	0.0056		
Toluene (mg/kg)	ND	0.0081	ND	0.0076		
Ethylbenzene (mg/kg)	ND	ND	ND	ND		
Xylenes (mg/kg)	ND	0.0013	ND	0.0024		
Moisture (%)	14.0	NR	18.2	NR		

NR Not reported.
ND Not detected.

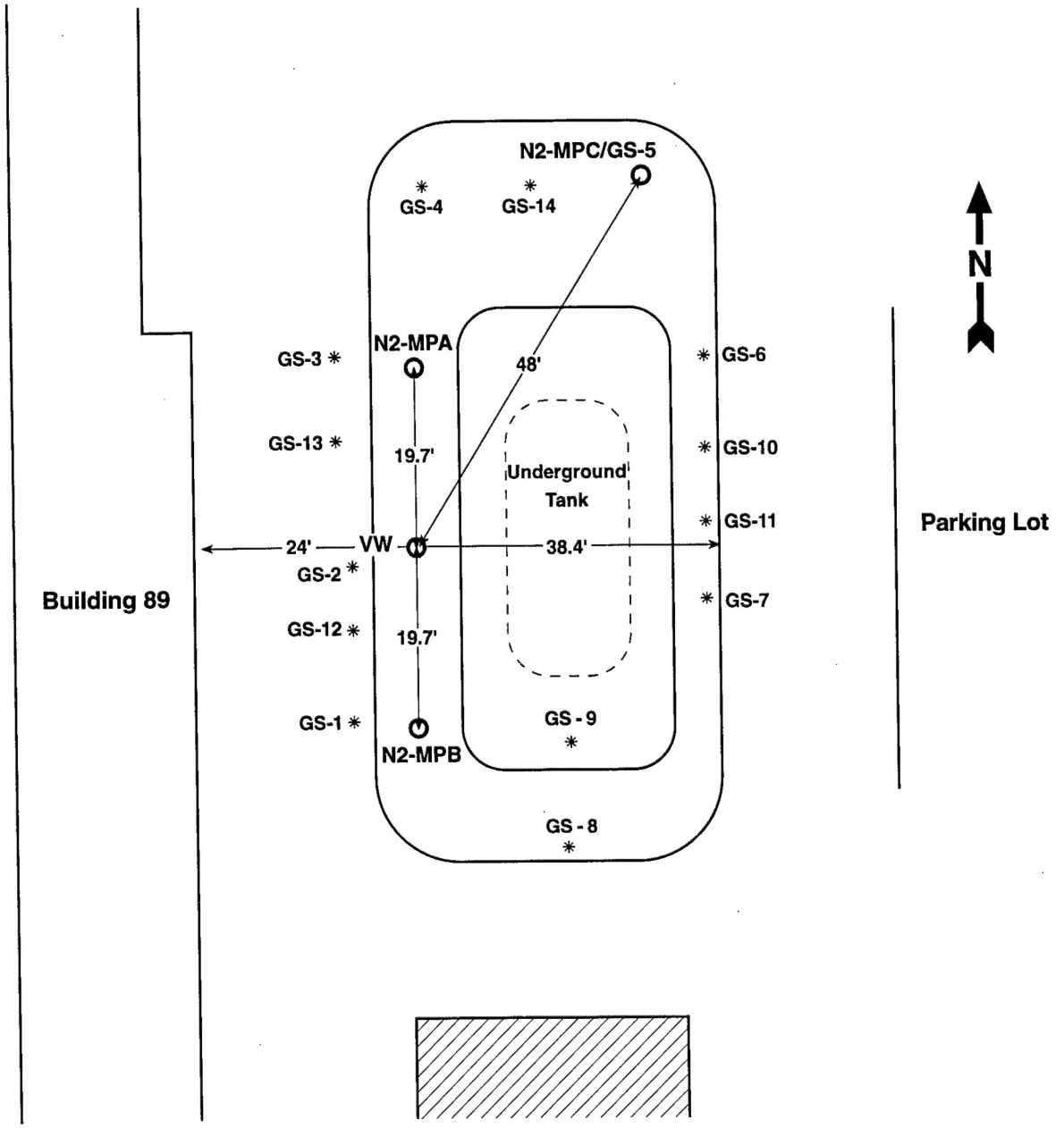

Figure 1. Schematic Diagram of Facility 89, Newark AFB, OH, Showing Locations of the Vent Well, Monitoring Points, and Soil Gas Survey Points

Table 1. Respiration and Degradation Rates at Facility 89, Newark AFB, OH

Location	Initial: August 7, 1993			6-Month: April 5, 1993			1-Year: November 8, 1993		
	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)	K_O (% O_2/day)	K_D (mg/kg/yr)	Soil Temperature (°C)
MPA-2.0				0.38	110		1.4	410	
MPA-4.5				No flow					
MPA-7.0	0.36	110	21.4	No flow			0[1]	0[1]	
MPB-5.0				0.16	47				
MPB-7.5	0.65	190		0.32	93		0.31	91	
MPB-10.0	0.34	99		0.063	18				
MPC-4.7							0.30	88	
MPC-6.5	0.65	190							

[1] No respiration observed at this monitroing point.

Table 2. Initial and 1-Year Soil and Soil Gas Analytical Results at Facility 89, Newark AFB, OH

Analyte (units)	Sample Location					
Soil Gas Hydrocarbons	MPC-6.5		MPC-9.0		VW	MPA-7.0
	Initial August 18, 1992	1-Year December 14, 1993	Initial August 18, 1992	1-Year December 14, 1993	Initial August 18, 1992	1-Year December 14, 1993
TPH (ppm)	7.8	24	3.5	20	74	150
Benzene (ppm)	0.0080	ND	0.0030	ND	ND	ND
Toluene (ppm)	0.027	ND	0.0060	ND	ND	ND
Ethylbenzene (ppm)	0.0020	ND	ND	ND	ND	ND
Xylenes (ppm)	0.012	0.0040	0.0040	ND	ND	ND
Soil Hydrocarbons	VW-9.0		VW-4.5		MPC-10.0	
	Initial July 31, 1992	1-Year November 11, 1993	Initial July 31, 1992	1-Year November 11, 1993	Initial July 31, 1992	
TPH (mg/kg)	ND	ND	31	12	ND	
Benzene (mg/kg)	ND	ND	ND	ND	ND	
Toluene (mg/kg)	ND	0.0046	ND	0.024	ND	
Ethylbenzene (mg/kg)	ND	ND	ND	ND	ND	
Xylenes (mg/kg)	ND	ND	ND	0.0021	ND	
Moisture (%)	16.8	NR	15.7	NR	21	

NR Not reported.
ND Not detected.